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MACRO ALGAE AS SUBSTRATE FOR BIOGASPRODUCTION

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AU RESEARCH FROM LAB TO FULL SCALE







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ALGAE SPECIES TESTED FOR BIOGAS

Brunalger (*Phaeophyceae*)

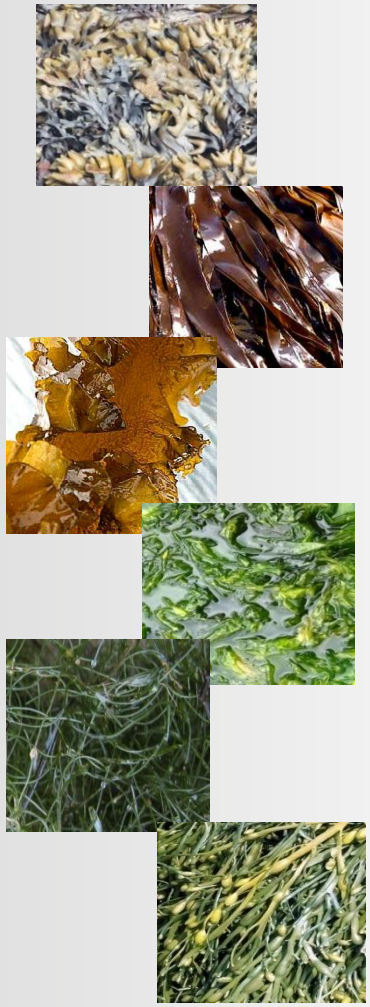
Fingertang (*Laminaria digitata*)

Sukkertang (*Saccharina L*)

Søsalat (*Ulva lactuca)*

Krølhårstang (*Chaetomorpha linum*)

Buletang *(Ascophyllum nodosum)*



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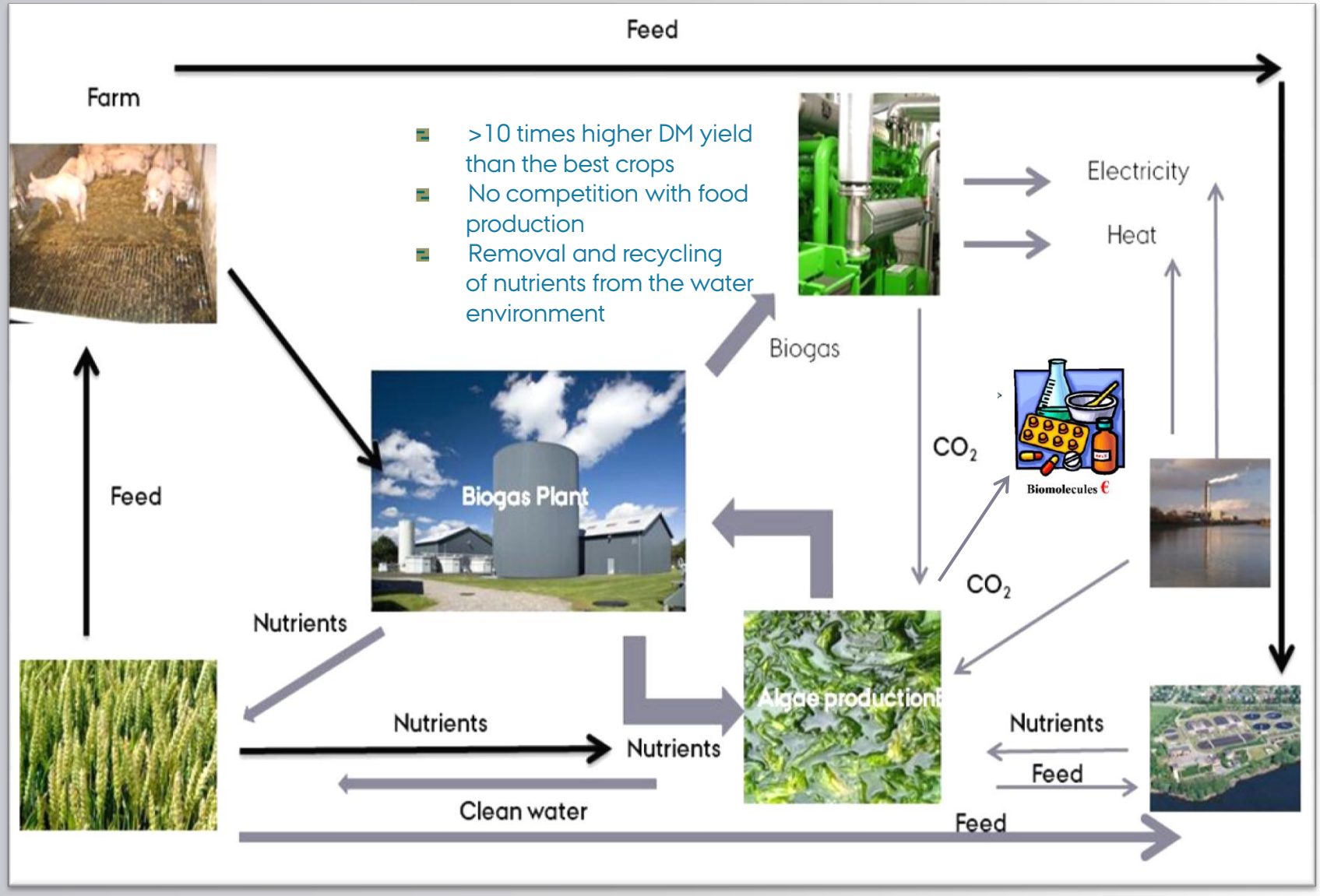
WHY ALGAE FOR BIOGAS



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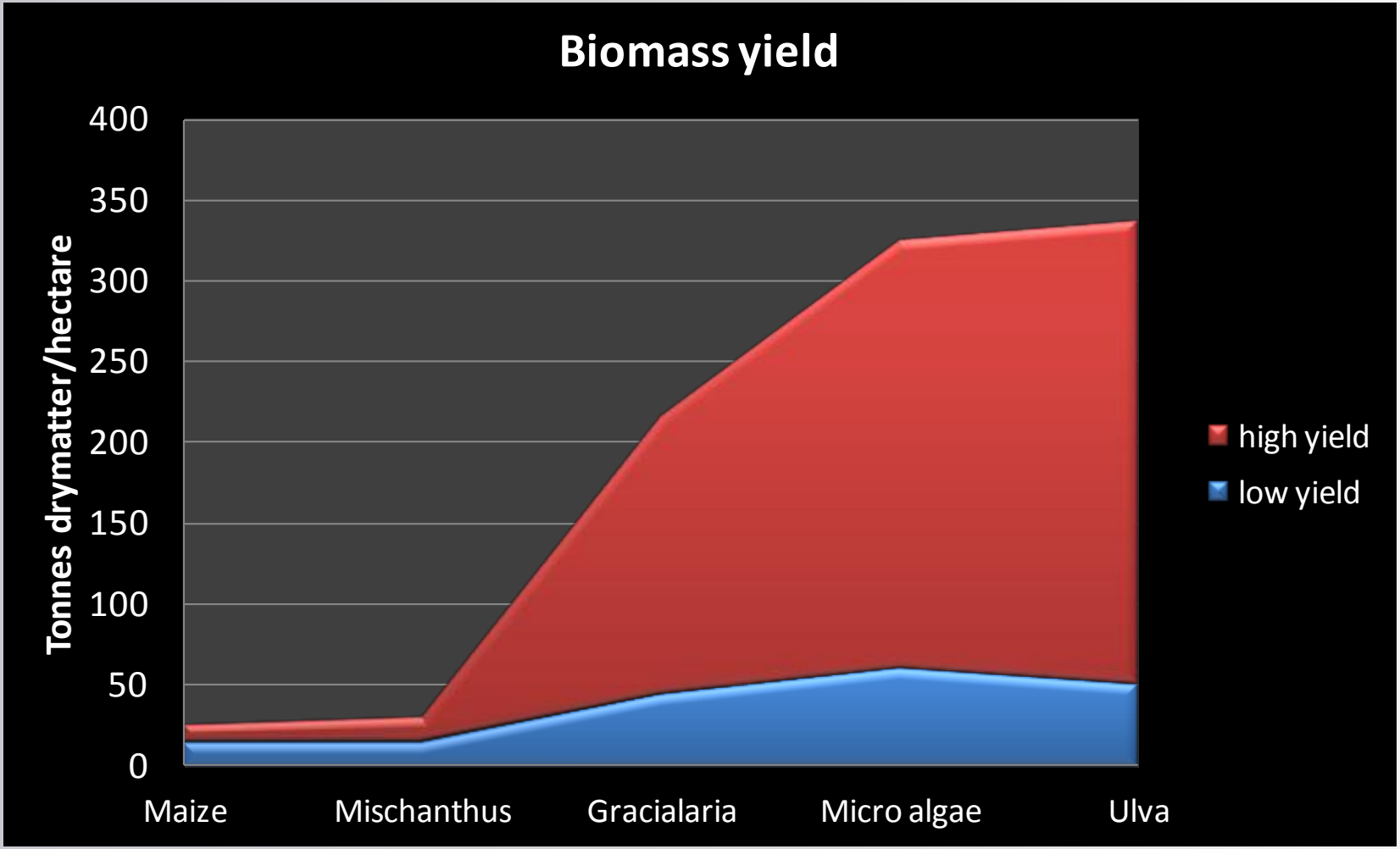
HARVEST POTENTIAL



Modified from Yannick Lerat 2011

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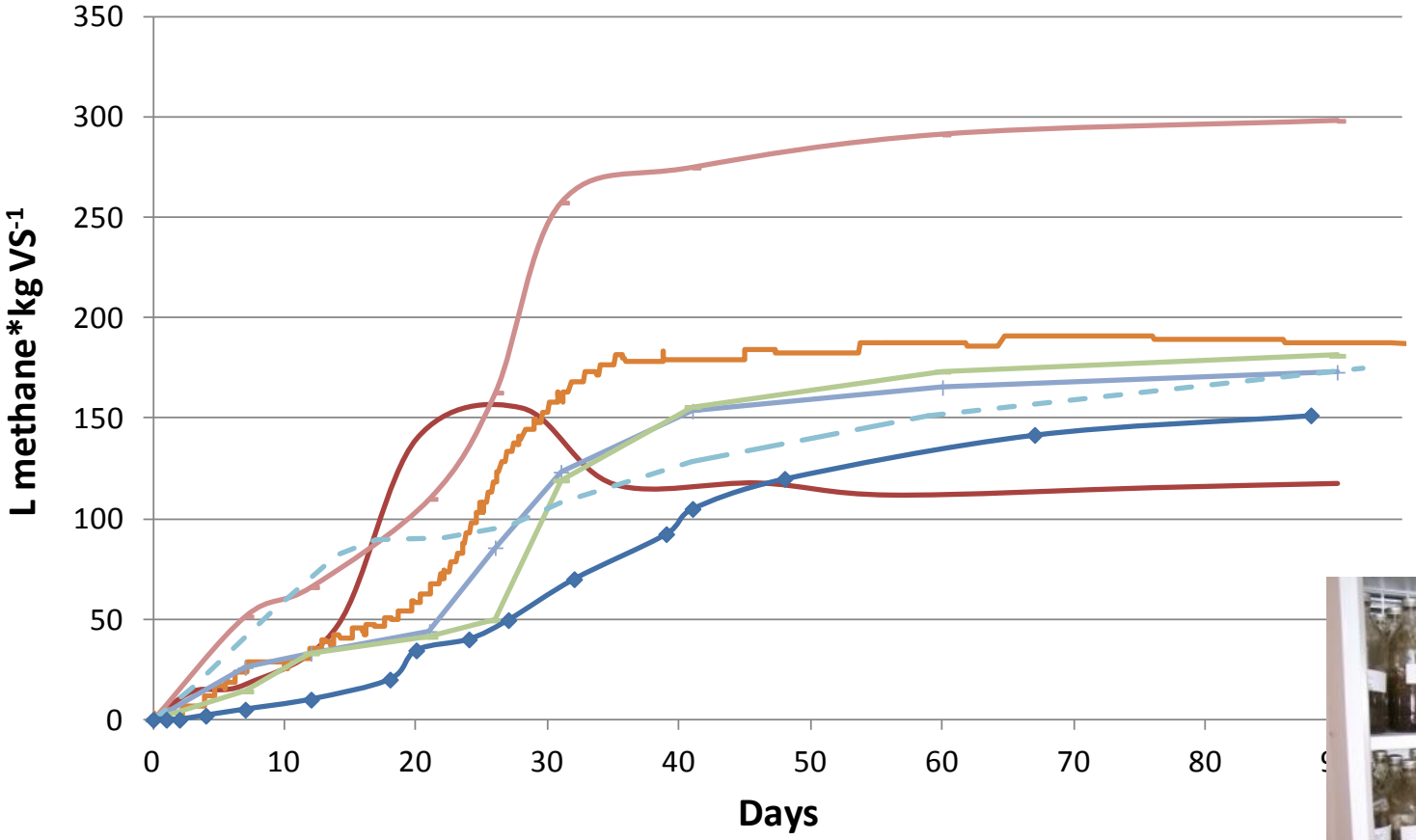
BIOGAS EXPERIMENTS-BATCH



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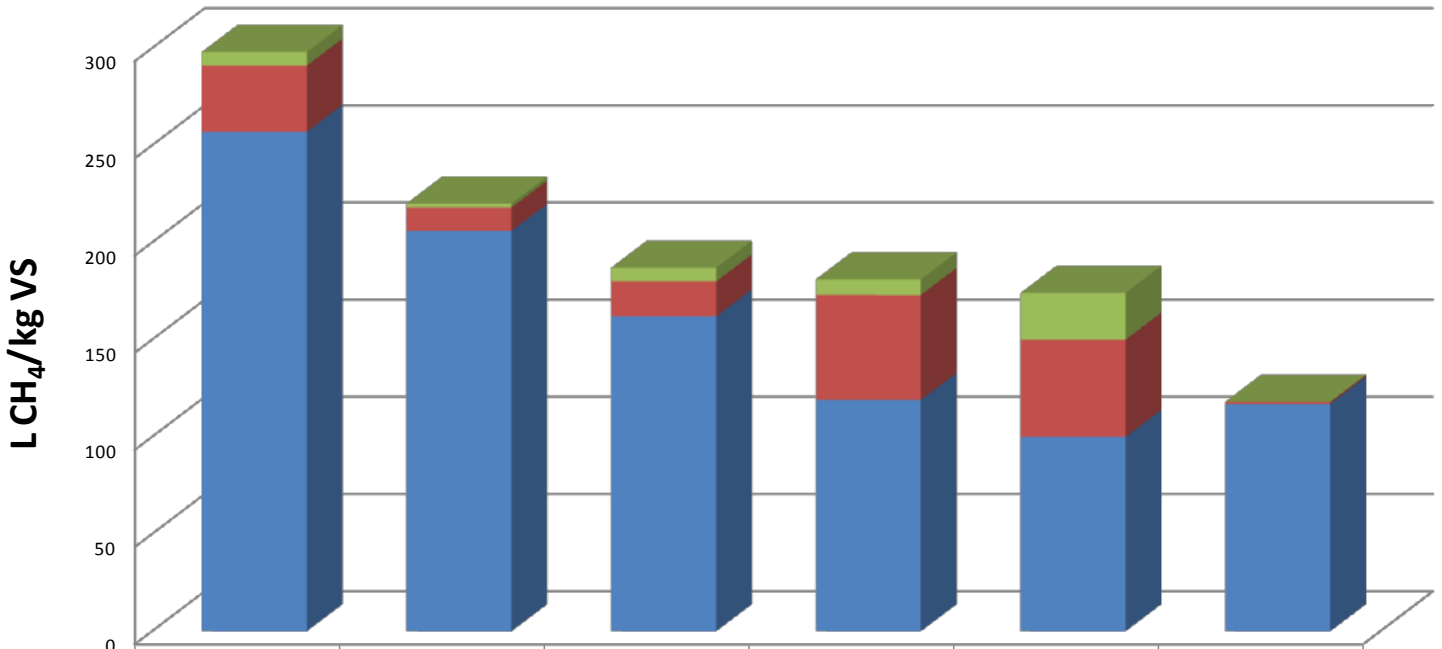
GASPOTENTIALS



	Laminaria	Saccharina	Chaetomorpha Linum	aschophyllum	Ulva lactua	Pilayella littoralis and Ectocarpus Siliculosus
90 days	7	2	7	8	24	0
60 days	34	12	18	54	50	1
30 daYS	257	206	162	119	100	117

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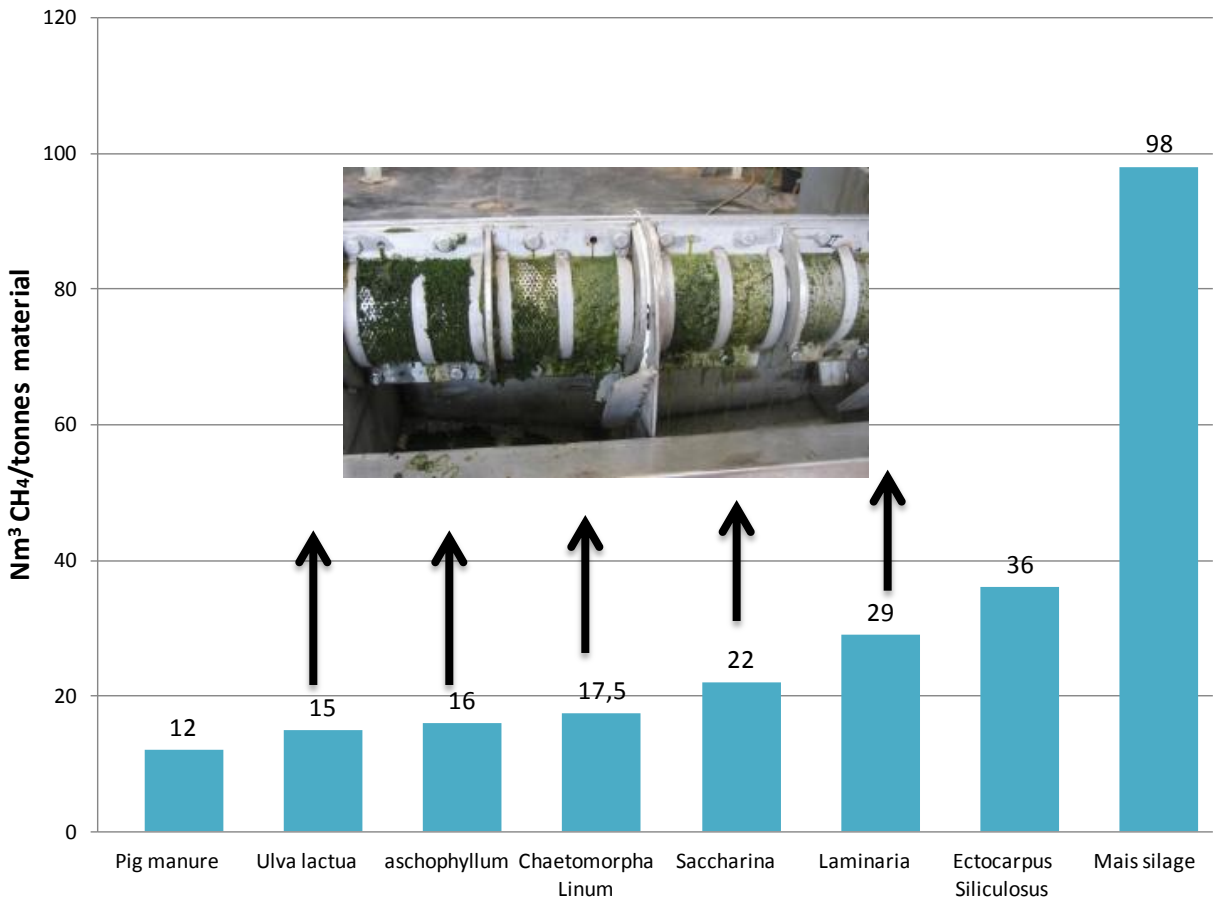
METHANE POTENTIALS



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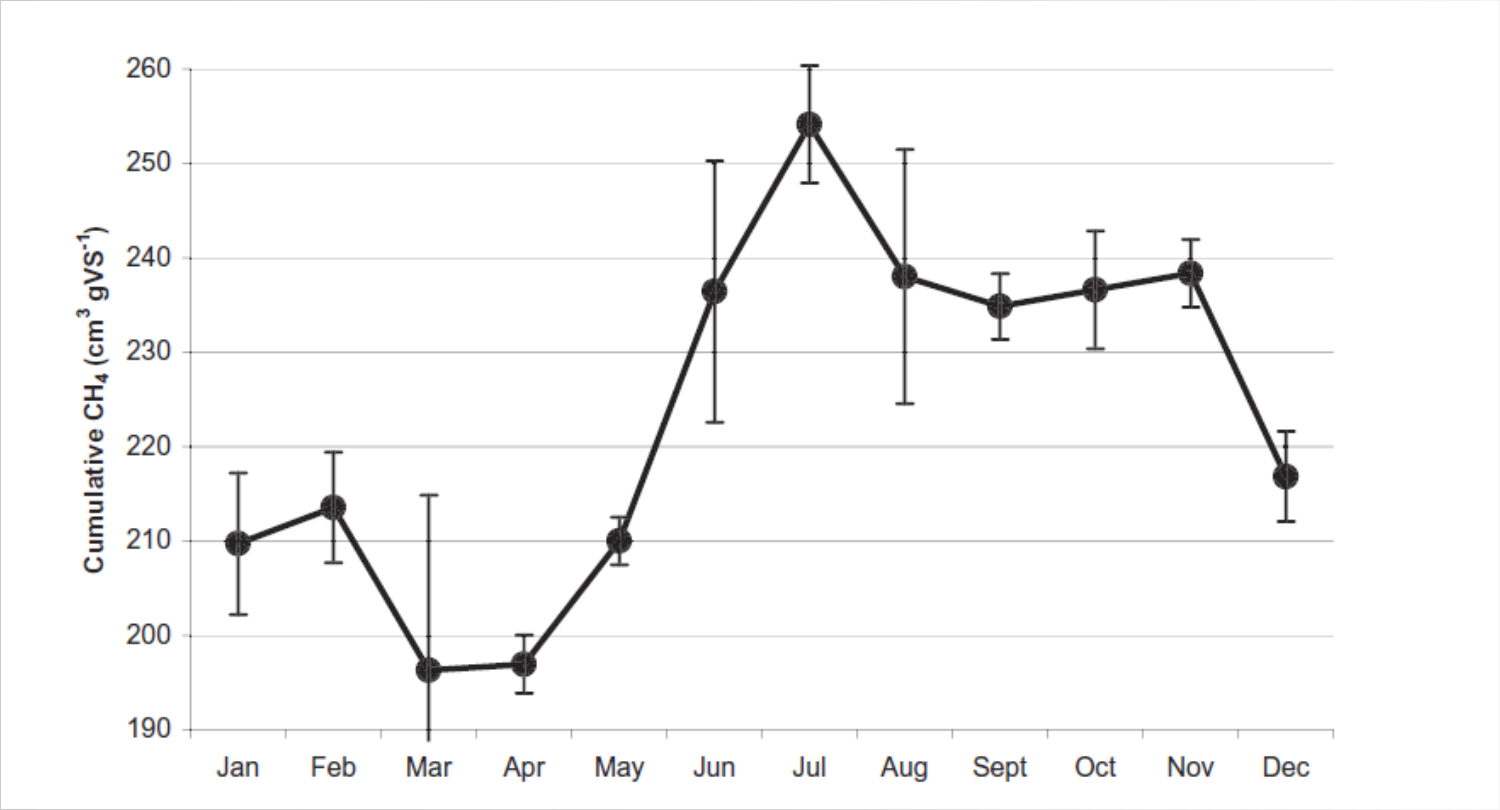
SEASONAL VARIATION OF BMP IN LAMINARIA



From Adams et al. 2011

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CONTINOUSLY EXPERIMENTS – CODIGESTION OF MANURE AND ALGAE

	Ulva			*Laminaria*			Control
%VS (algae:manure)	11:89	24:76	37:63	15:85	24:76	41:59	0:100
HRT, days	22			22			22
Temp.(°C)	50			50/35			50/35

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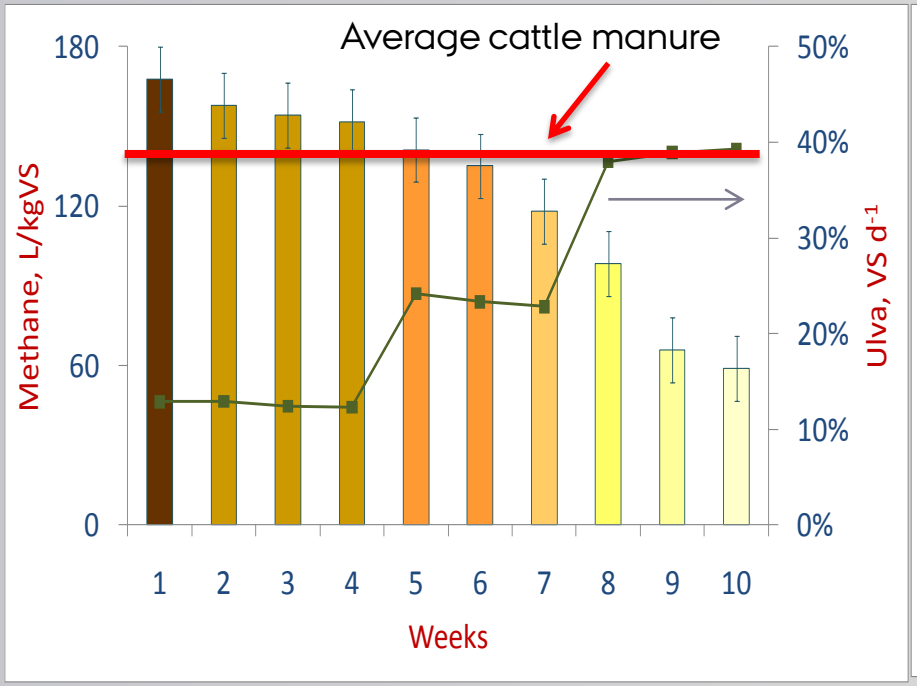
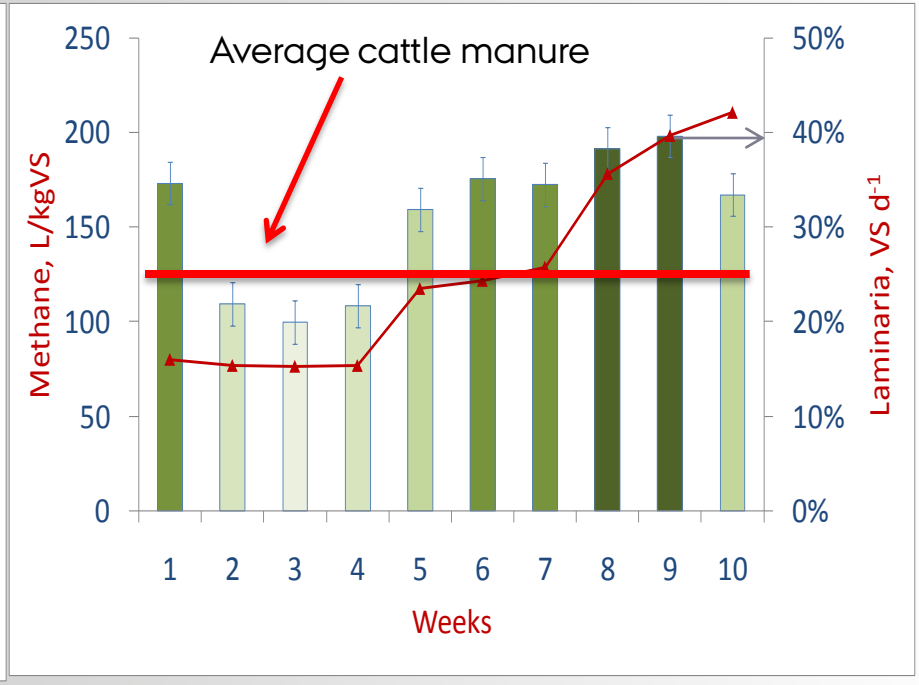
RESULTS OF CONTINOUSLY THERMOPHILIC EXPERIMENTS



Ulva lactua



Laminaria

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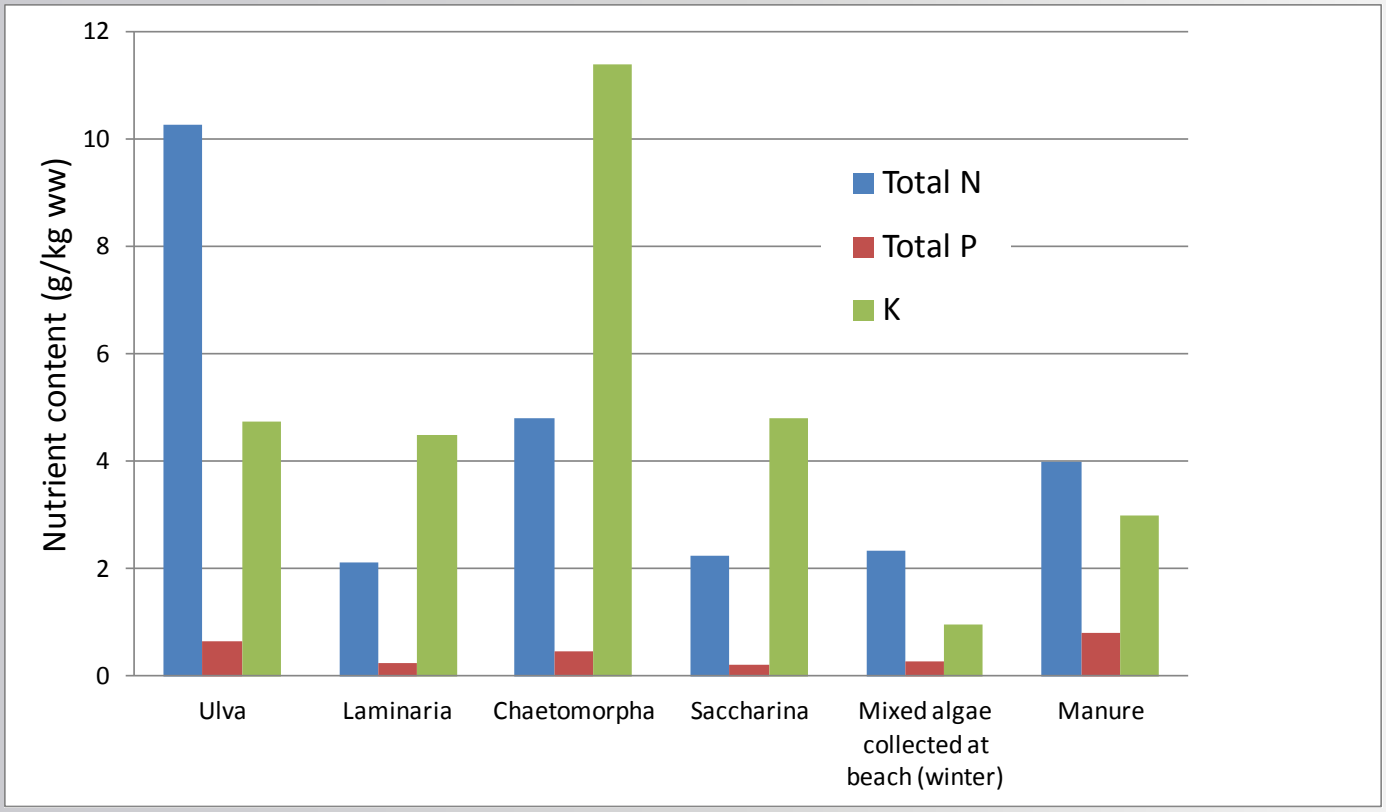
FERTILIZER VALUE – DIGESTATE USE FOR ORGANIC FARMING



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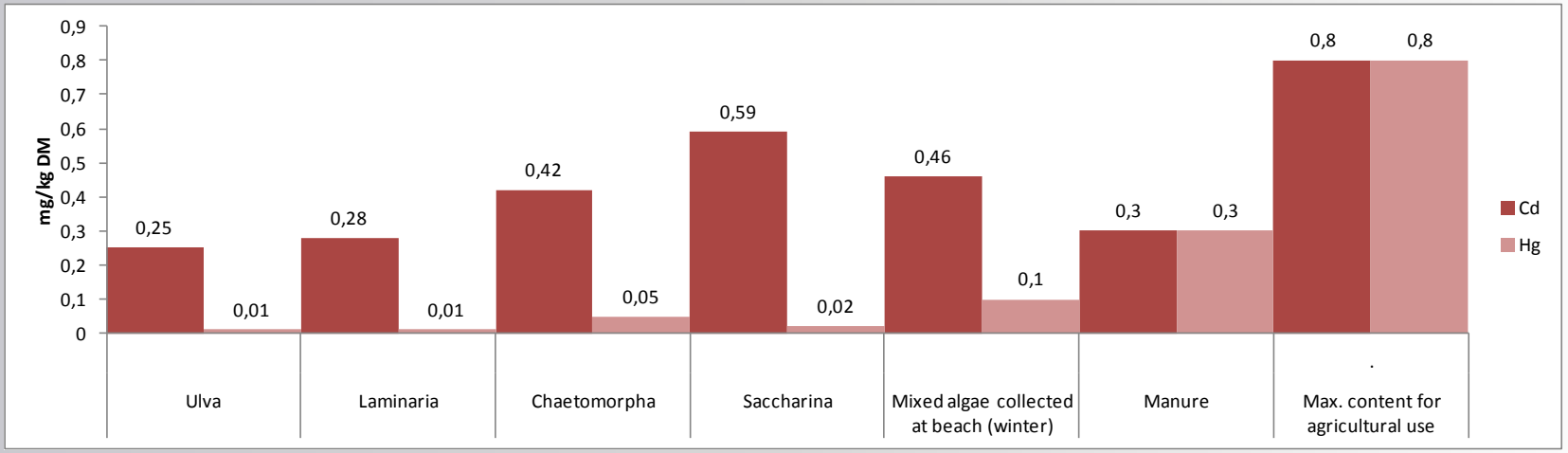
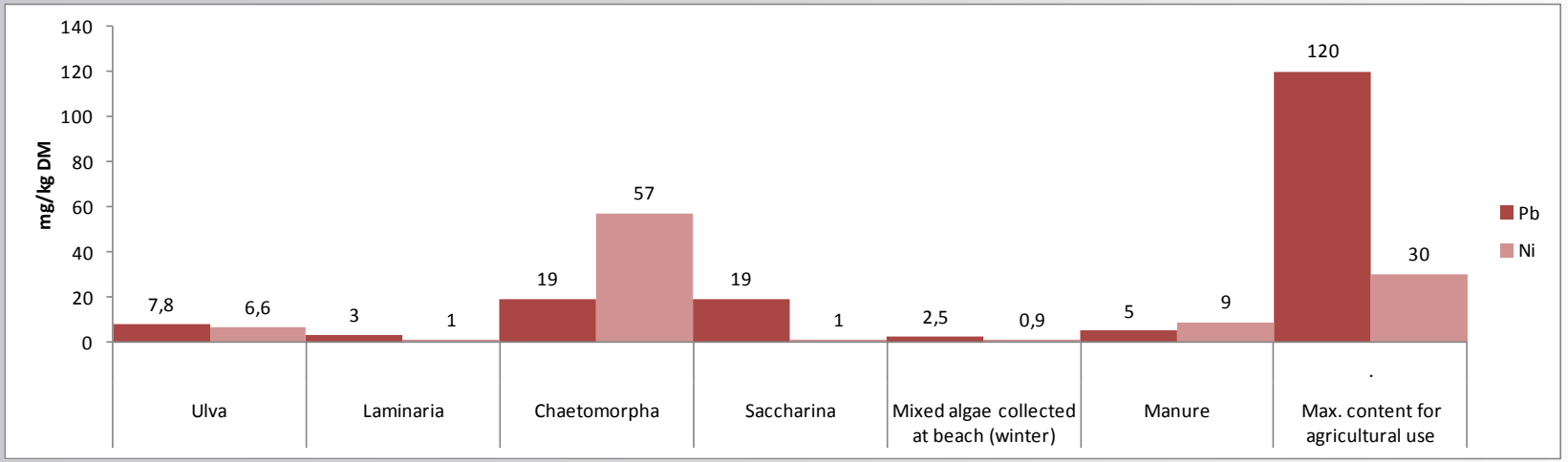
FERTILIZER AND HEAVYMETALS





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OFF SHORE HARVEST/CULTIVATION OR CULTIVATION IN BASINS

Line cultivation

Sea harvest

Beach 'harvest'

Basin cultivation

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ECONOMICS

- Production costs: **3 kr/kg DM**
- Methane value: **1-2 kr/kg DM**
- **How to make it profitable:**
- Value of nitrogen for organic farming:
- **0,5 kr/kg DM (15 kr/kg N)**

- Payment for N removal from water environment: >**75 kr/kg N**
- Extraction of products of high value and only using the by product for biogas

- Value on the removal from beaches etc. **??**

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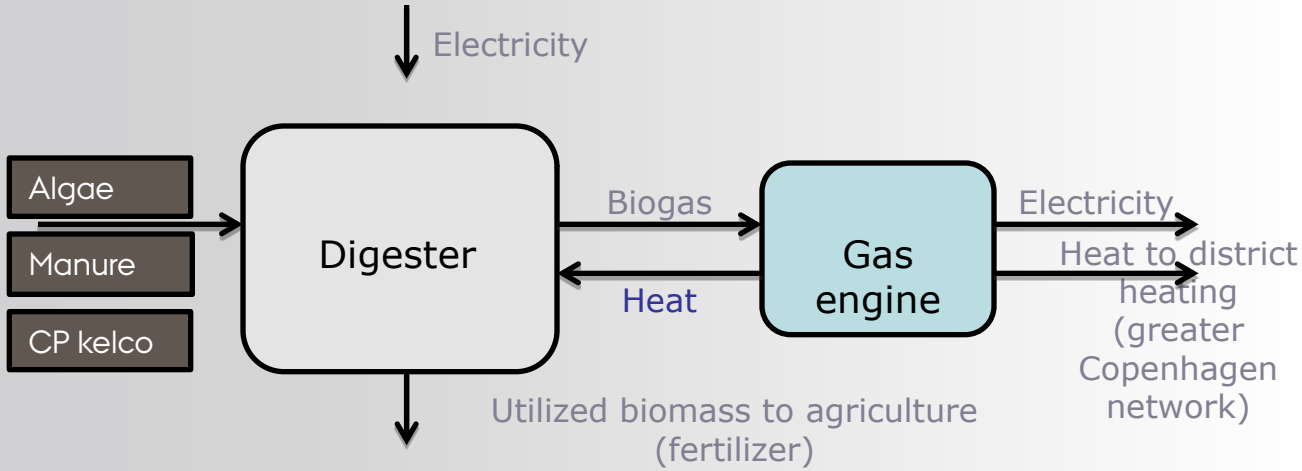
EXAMPLE OF A COMING BIOGAS PLANT BASED ON ALGAE - SOLRØD

- 4,000 tons of cast seaweed is removed annually from a 3.7 km stretch of beach in Solrød Municipality (3.7 km).



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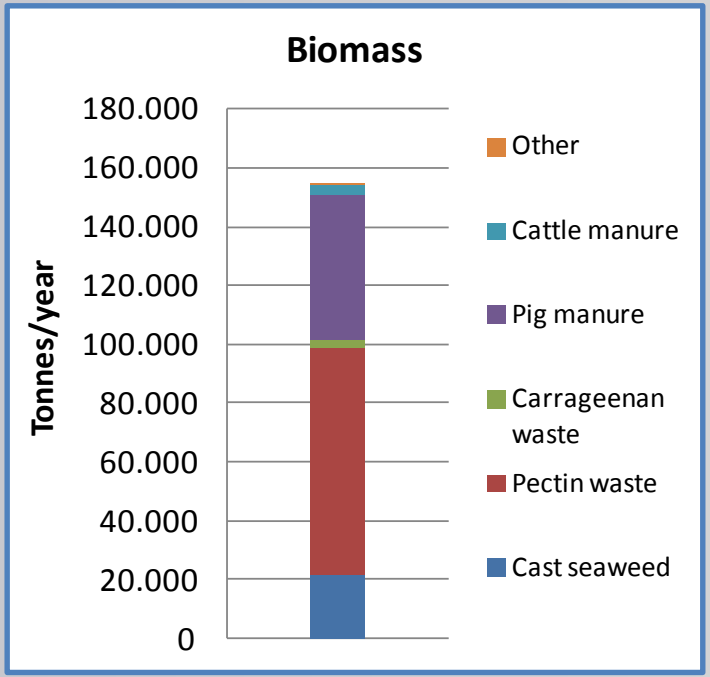
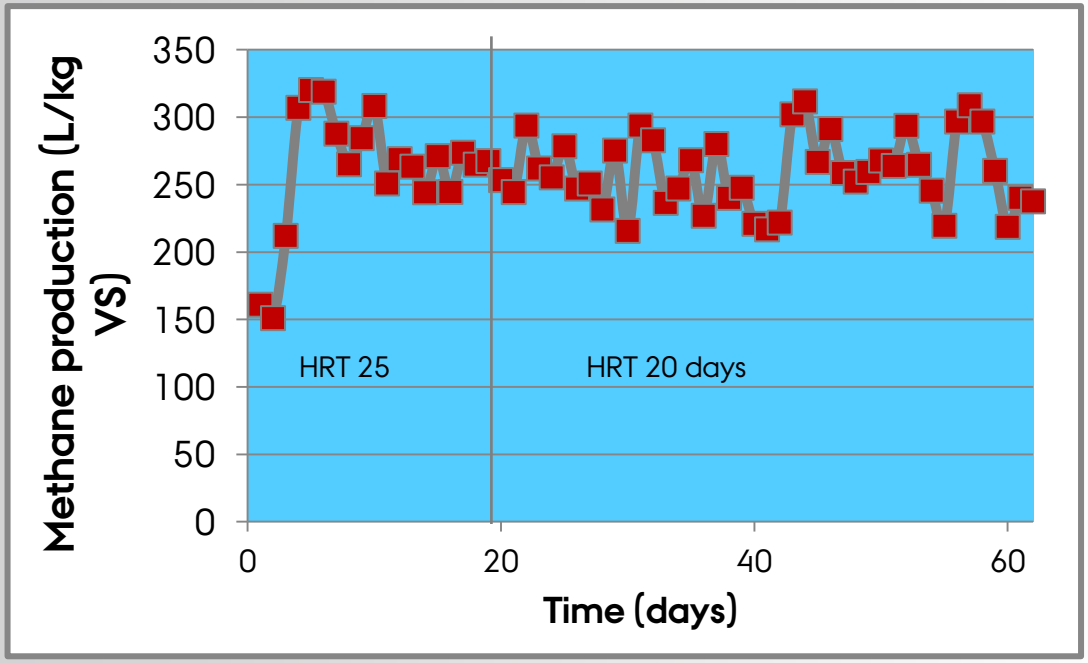
BIOGAS PLANT BASED ON ALGAE - SOLRØD





The process is very stable, Methane Production >260 L/kg VS or 1.61 l/l of reactor per day, Methane content : 59%

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CONCLUSIONS

- Algae is a very high yielding biomass that will not compete with food production. Ulva can have a drymatter yield that is more than 10 times higher than crops
- Laminaria was found to be the macro algae with highest gaspotential 250-300 L CH_4/kg VS.
- Co-digestion of algae with manure is advantageous but the ratio that can be used depends on algae species, Laminaria is superior
- Digestate is a high value fertilizer with low heavy metal content
- Cultivation of algae for biogas is not economical feasible today, but valuing environmental benefits, extraction of high value components or collection of cast seaweed at beaches might be ways to integrate algae in biogasplants as in Solrød


THANKS FOR YOR
ATTENTION